AEC Design process

Design

Cost Estimation

Specification
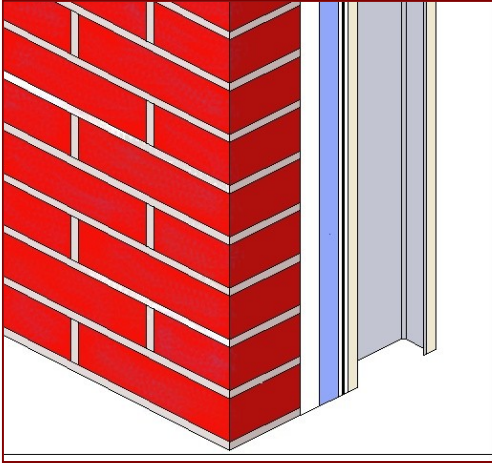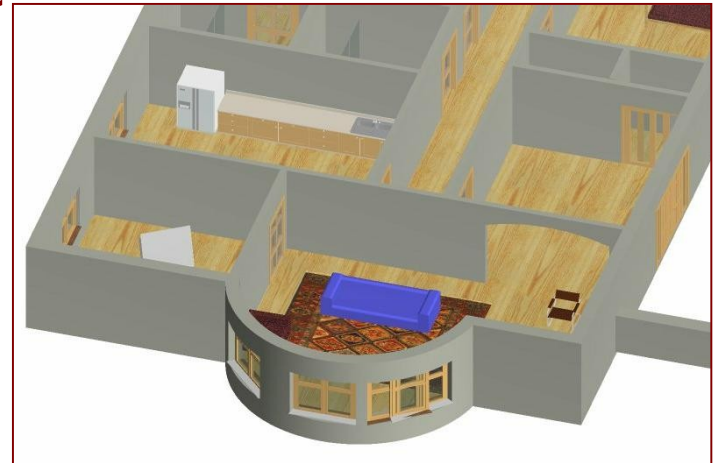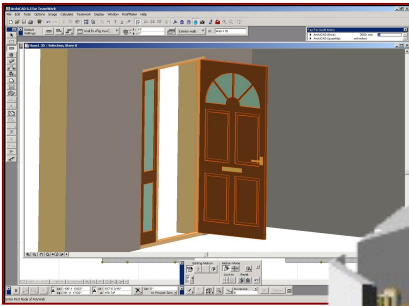
Designers build spaces by using walls, doors, windows, floors, etc.

Each wall, floor, roof, window can be a collection of subcomponents:

- brick
- concrete
- studs

The building

Initially, Designers are usually focused on the general form and organization rather than the detailed subcomponents such as type of wall, door, window or floor.

Initial cost estimates are made from this general information.

The **Uniformat** system is designed around this concept of general information for which specific information will be added later, pending feasibility of the project based upon the initial cost estimates.
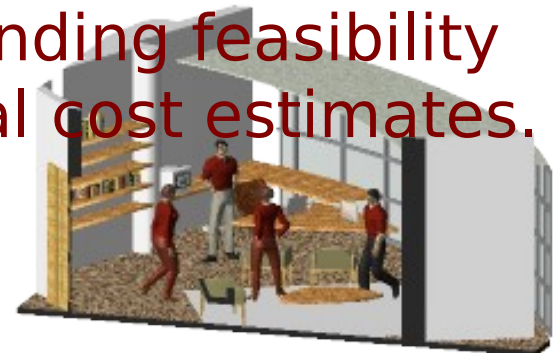
AEC Design process

- The Facility Design Business process:
  - Create CAD Model
    - Extract materials Areas, quantities:
      - Send to Cost estimator
    - Extract materials: Specific
      - Send to Specifications Writer
  - Edit CAD Model
    - Reduce area, delete door, window
      - Update cost information
        - Reduce the area multiplier
        - Eliminate Door, Window from cost
      - Update Specifications information
        - Check to see if a section, material needs to be deleted from the specifications.

CADD to Cost to Spec

- Link between the
  - CADD and
  - the Specifications and
  - the Cost Estimating

- The Specifications and Cost estimate depend upon the **current** information in the CAD Model to provide the information necessary for the Specifier and the Cost Estimator to accomplish their role in the building process.
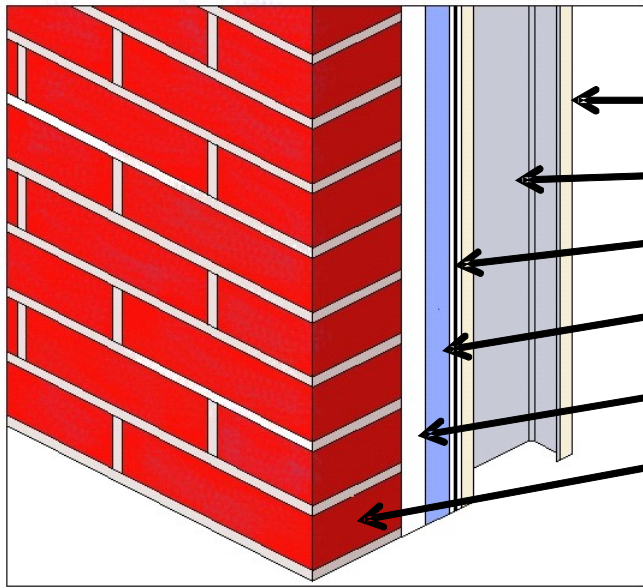
UNIFORMAT II

- UNIFORMAT II Classification
  - Classification for Building "Assemblies" for preliminary design and cost estimates.
    - A complete exterior wall is classified as a B2010
      - The wall will be made of multiple components.
      - The wall will be assigned a cost per unit area.

UNIFORMAT II LEVEL 2 GROUP	Ratio	ELEMENT				Cost per	% Trade
Level 3 Elements	Qty/GFA	Qty	Unit	Rate	Amount	Unit GFA	Cost
A10 **FOUNDATIONS**					45,400	1.00	2.1%
A1010 Standard Foundations	0.21	8,500	FPA	4	32,000	0.7	
A1020 Special Foundations	0.05	450	SF	1.1	1,200	0.1	
A1030 Slab on Grade	0.15	8,500	SF	2.1	12,200	0.2	
A20 **BASEMENT CONSTRUCTION**					1,113,500	22.50	2.1%
A2010 Basement Excavation	0.05	1,200	CY	11.12	18,000	0.4	
A2020 Basement Walls	0.1	4,500	SF	15.1	17,000	0.7	
B10 **SUPERSTRUCTURE**					1,078,500	21.40	18.2%
B1010 Floor Construction	0.85	50,000	SF	15.1	480,000	9.1	
B1020 Roof Construction	0.15	20,000	SF	6.71	48,000	1.1	
B20 **EXTERIOR CLOSURE**					550,500	11.20	15.5%
B2010 Exterior Walls	0.55	35,000	SF	17.7	321,000	6.5	
B2020 Exterior Windows	0.15	4,700	SF	42.42	221,000	4.5	
B2030 Exterior Doors	0.02	6	LVS	1100	8,500	0.2	

Wall : Cost & Specification Links

Gyp. Bd. Type X, 5/8"

MTL. STUD, GALVANIZED, 3-5/8"

VAPOR BARRIER, 15#FELT

RIGID INSULATION, 1"

AIR SPACE, 1"

BRICK; MODULAR

OBJECT	UNIFORMAT	MasterFormat Division	Components	Type	Size	Quantity Area		LINK TO:
Wall	B2010							COST
		4210	Brick	Modular				SPEC
			Air Space		1"			
		7210	Insulation	Rigid	1-1/2"			SPEC
		7260	Vapor Barrier	Felt	15#			SPEC
		6160	Sheathing		5/8"			SPEC
		5410	Metal Stud	Galvanized	3-1/2"			SPEC
		9250	Gyp. Bd.	Type 'X', WP	5/8"			SPEC

CADD Model

OBJECT	UNIFORMAT II	MasterFormat Division	Components	Type	Size	Quantity		LINK TO:
Wall	**B2010**					**Area**		COST
		4210	Brick	Modular				SPEC
			Air Space		1"			
		7210	Insulation	Rigid	1-1/2"			SPEC
		7260	Vapor Barrier	Felt	15#			SPEC
		6160	Sheathing		5/8"			SPEC
		5410	Metal Stud	Galvanized	3-1/2"			SPEC
		9250	Gyp. Bd.	Type 'X', WP	5/8"			SPEC
Door	**B2030**					Unit		COST
		8110	Door	Wood, B-Label	36x84			SPEC
		8710	Hardware	Set Number				SPEC
		8810	Glazing	Insulated	1"			SPEC
		8110	Frame	Steel, B-Label	36x84			SPEC
		8720	Weatherstripping					SPEC

A Rose

A rose by any other name

**Is not a Rose**

(to a database)

IFC Material Properties

The IFC Information contains a group of individual materials composing a wall Object.

- The materials have size information in a standard format, but there is not a standard for the Materials: No standard naming convention.

List of IFC Materials

List of IFC Information for multiple Walls:

```
4       IFCMATERIAL             ('Brick Face ')
46      IFCMATERIAL             ('Air Space')
48      IFCMATERIAL             ('Insulation Rigid ')
50      IFCMATERIAL             ('Block Concrete ')
52      IFCMATERIAL             ('_1 5/8"Steel St.@16"o.c+Batt In')
54      IFCMATERIAL             ('Gypsum Board+Vapor Barrier')
131     IFCMATERIAL             ('Vapor Barrier+Bldg.Paper')
133     IFCMATERIAL             ('_2x6 Wd.Studs@16"o.c.+R-
19Batt')

204     IFCMATERIAL             ('Gypsum Firecode')
206     IFCMATERIAL             ('_3 5/8"Steel St.@24"o.c')
271     IFCMATERIAL             ('Stucco')
273     IFCMATERIAL             ('Exterior Sheathing+Bldg.Paper')
275     IFCMATERIAL             ('_2x4 Wd.Studs@12"o.c.Spr.No.2')
344     IFCMATERIAL             ('T & G Gypsum Coreboard')
```

IFC Wall Information
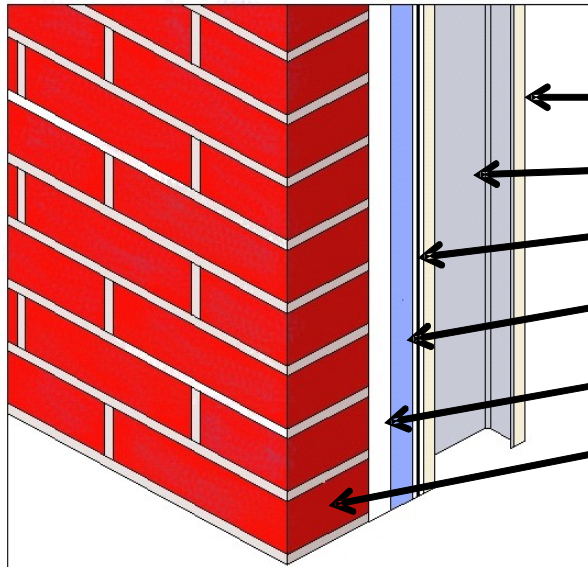
Gyp. Bd. Type X, 5/8"

MTL. STUD, GALVANIZED, 3-5/8"

VAPOR BARRIER, 15#FELT

RIGID INSULATION, 1"

AIR SPACE, 1"

BRICK; MODULAR

Wall:

A collection of subcomponents.

The Wall will represent a specific cost. The Subcomponents will relate to the specifications.

56	IFCMATERIALLAYERSET	#45, #47, #49, #51, #53, #55	((#45, #47, #49, #51, #53, #55), 'Wall Br.+Rig.Ins+C.Block +Fur.')
45	IFCMATERIALLAYER	#44	(#44, 3.99999951659176, $)
44	IFCMATERIAL		('Brick Face ')
47	IFCMATERIALLAYER	#46	(#46, 0.9999999879147941, $)
46	IFCMATERIAL		('Air Space')
49	IFCMATERIALLAYER	#48	(#48, 1.999999975829588, $)
48	IFCMATERIAL		('Insulation Rigid ')
51	IFCMATERIALLAYER	#50	(#50, 6.000000074153737, $)
50	IFCMATERIAL		('Block Concrete ')
53	IFCMATERIALLAYER	#52	(#52, 1.624999934528737, $)
52	IFCMATERIAL		('_1 5/8"Steel St.@16"o.c+Batt In')
55	IFCMATERIALLAYER	#54	(#54, 0.499999993957397, $)
54	IFCMATERIAL		('Gypsum Board+Vapor Barrier')

IFC File Information

#44 = IFCMATERIAL ('Brick Face ');

#45 = IFCMATERIALLAYER (#44, 3.999999951659176, $);

#46 = IFCMATERIAL ('Air Space');

#47 = IFCMATERIALLAYER (#46, 0.9999999879147941, $);

#48 = IFCMATERIAL ('Vapor Barrier+Bldg.Paper');
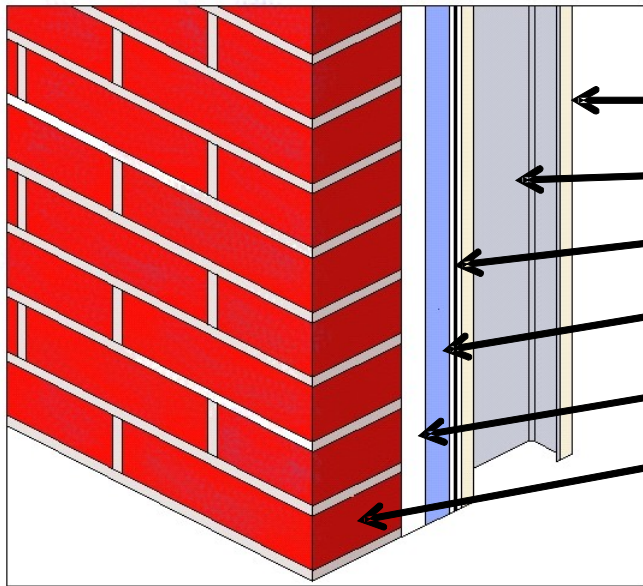
#49 = IFCMATERIALLAYER (#48, 1.500000018538434, $);

#50 = IFCMATERIAL ('_2x4 Wd.Studs@16"o.c+R-12Batt I');

#51 = IFCMATERIALLAYER (#50, 3.499999994368022, $);

#52 = IFCMATERIAL ('Gypsum Board+Vapor Barrier');

#53 = IFCMATERIALLAYER (#52, 0.499999993957397, $);

#54 = IFCMATERIALLAYERSET ((#45, #47, #49, #51, #53), 'Wall Br.Vr+v.b.+2x4Wd.S.@16"');
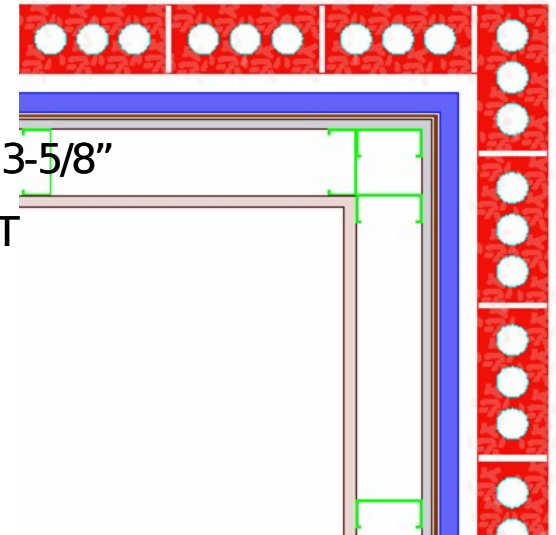
Gyp. Bd. Type X, 5/8"

MTL. STUD, GALVANIZED, 3-5/8"

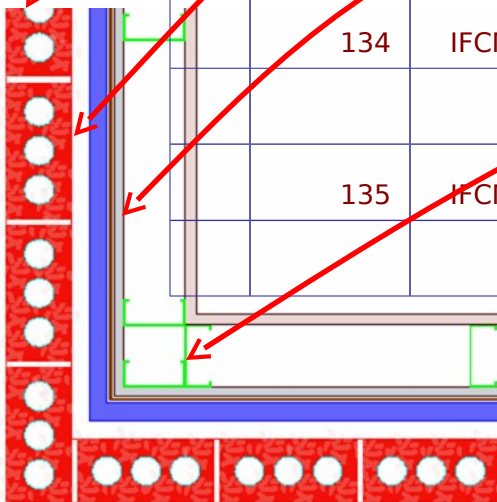VAPOR BARRIER, 15#FELT

RIGID INSULATION, 1"

AIR SPACE, 1"

BRICK; MODULAR

OBJECT	UNIFORMAT	MasterFormat Division	Components	Type	Size	Quantity Area		LINK TO:
Wall	B2010							COST
		4210	Brick	Modular				SPEC
			Air Space		1"			
		7210	Insulation	Rigid	1-1/2"			SPEC
		7260	Vapor Barrier	Felt	15#			SPEC
		6160	Sheathing		5/8"			SPEC
		5410	Metal Stud	Galvanized	3-1/2"			SPEC
		9250	Gyp. Bd.	Type 'X', WP	5/8"			SPEC

IFC Information

13			
6 IFCMATERIALLAYERSET			((#129, #130, #132, #134, #135), 'Wall Br.Vr.+v.b.+2x6Wd.S.@16"')
			#129, #130, #132, #134, #135
129	IFCMATERIALLAYER	#44	(#44, 3.999999951659176, $)
	44	IFCMATERIAL	('Brick Face ')
130	IFCMATERIALLAYER	#46	(#46, 0.9999999879147941, $)
	46	IFCMATERIAL	('Air Space')
132	IFCMATERIALLAYER	#131	(#131, 1.500000018538434, $)
	131	IFCMATERIAL	('Vapor Barrier+Bldg.Paper')
134	IFCMATERIALLAYER	#133	(#133, 5.499999823532638, $)
	133	IFCMATERIAL	('_2x6 Wd.Studs@16"o.c.+R-19Batt')
135	IFCMATERIALLAYER	#54	(#54, 0.499999993957397, $)
	54	IFCMATERIAL	('Gypsum Board+Vapor Barrier')

IFC exterior wall

IFC Material Information for Unique Links:

- ('Brick Face ')
- ('Air Space')
- ('Vapor Barrier+Bldg.Paper')
- ('_2x6 Wd.Studs@16"o.c.+R-19Batt')
- ('Gypsum Board+Vapor Barrier')

IFC Wall Information

#54 = IFCMATERIALLAYERSET ((#45, #47, #49, #51, #53), 'Wall Br.Vr+v.b.+2x4Wd.S.@16"');

```
54   IFCMATERIALLAYERSET   #45, #47, #49, #51, #53   ((#45, #47, #49, #51, #53), 'Wall Br.Vr+v.b.+2x4Wd.S.@16"')
   45   IFCMATERIALLAYER   #44   (#44, 3.999999951659176, $)
      44   IFCMATERIAL   (")
   47   IFCMATERIALLAYER   #46   (#46, 0.9999999879147941, $)
      46   IFCMATERIAL   ('Air Space')
   49   IFCMATERIALLAYER   #48   (#48, 1.500000018538434, $)
      48   IFCMATERIAL   (")
   51   IFCMATERIALLAYER   #50   (#50, 3.499999994368022, $)
      50   IFCMATERIAL   ('_2x4 Wd.Studs@16"o.c+R-12Batt I')
   53   IFCMATERIALLAYER   #52   (#52, 0.499999993957397, $)
      52   IFCMATERIAL   (")
```

Wall Br.Vr+v.b.+2x4Wd.S.@16"

- Wall
- Br.Vr : Brick Veneer
- 2x4Wd.S. 2"x4" (nominal) Wood Stud
- @16" studs at 16" o.c.

IFC Property Set Information

IFC Wall Information includes rendering information for the Objects (for the Faces of the composite "Wall" and graphics representation .

Wall Type

Wall

Definition from IAI: This enumeration defines the different types of walls an *IfcWallType* object can fulfill:
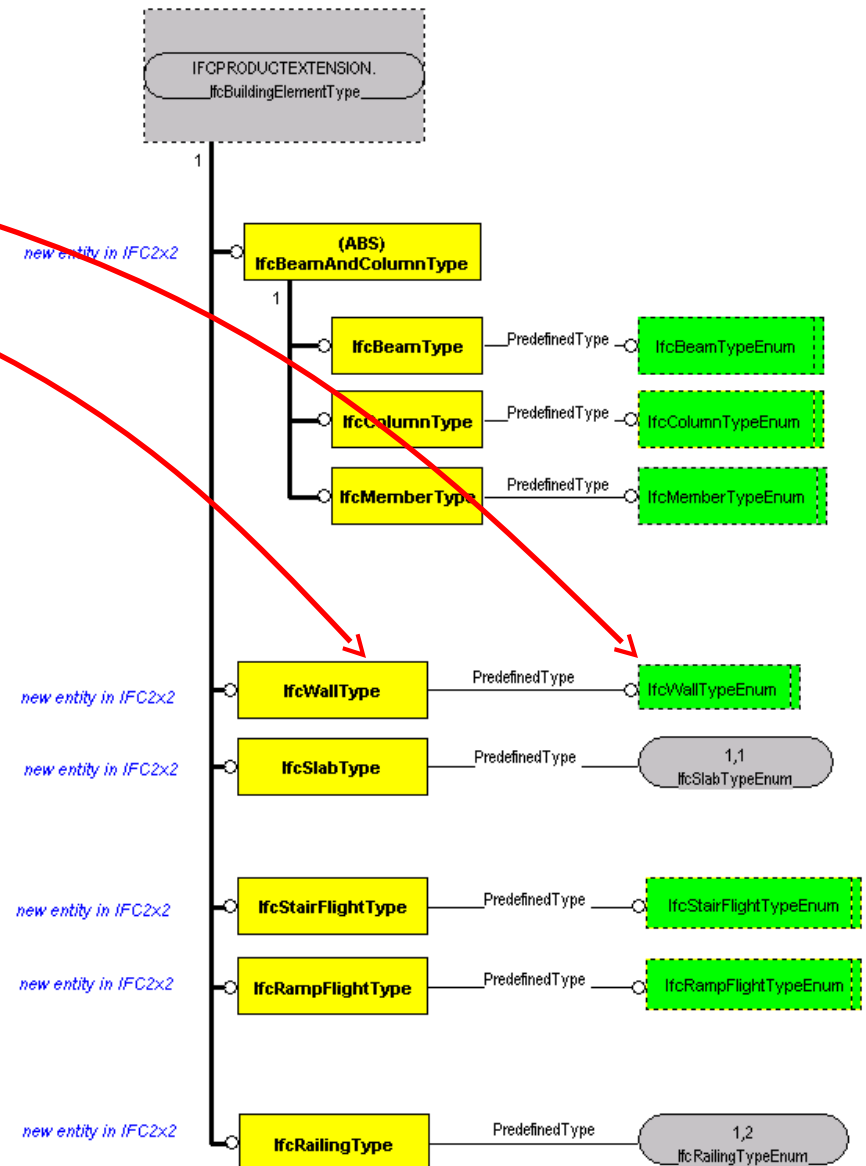
STANDARD: A standard wall, extruded vertically with a constant thickness along the wall path.

POLYGON: A polygonal wall, extruded vertically, where the wall thickness changes along the wall path.

SHEAR: A shear wall, having a non-rectangular cross section.

USERDEFINED: User-defined wall element.

NOTDEFINED: Undefined wall element

IFCPRODUCTEXTENSION.
IfcBuildingElementType

1

new entity in IFC2x2 — (ABS) IfcBeamAndColumnType

1

IfcBeamType — PredefinedType — IfcBeamTypeEnum

IfcColumnType — PredefinedType — IfcColumnTypeEnum

IfcMemberType — PredefinedType — IfcMemberTypeEnum

new entity in IFC2x2 — IfcWallType — PredefinedType — IfcWallTypeEnum

new entity in IFC2x2 — IfcSlabType — PredefinedType — 1,1 IfcSlabTypeEnum

new entity in IFC2x2 — IfcStairFlightType — PredefinedType — IfcStairFlightTypeEnum

new entity in IFC2x2 — IfcRampFlightType — PredefinedType — IfcRampFlightTypeEnum

new entity in IFC2x2 — IfcRailingType — PredefinedType — 1,2 IfcRailingTypeEnum

IFC materials list

IFCMATERIAL:

- 44   IFCMATERIAL ('Gypsum Firecode')
- 46   IFCMATERIAL ('_3 5/8"S.St.@24"o.c+3 1/2" S.Bl')
- 1301   IFCMATERIAL ('Brick Face ')
- 1303   IFCMATERIAL ('Air Space')
- 1305   IFCMATERIAL ('Insulation Rigid ')
- 1307   IFCMATERIAL ('Block Concrete ')
- 1309   IFCMATERIAL ('_1 5/8"Steel St.@16"o.c+Batt In')
- 1311   IFCMATERIAL ('Gypsum Board+Vapor Barrier')
- 75281   IFCMATERIAL ('Solid Fill')

European UNICLASS Construction Products:

L661.2 Plasterboard

L322.2.1 Lightweight Concrete Blocks

L321.1.2 Facing Brick

Questions ?